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UNITED STATES PATENT AND TRADEMARK OFFICE

COMMISSIONER FOR PATENTS
UNITED STATES PATENT AND TRADEMARK OFFICE
P.O. BOX 1450
ALEXANDRIA, VA 22313-1450
www.uspto.gov

Jacobson Holman PLLC
400 Seventh Street, NW
Suite 600
Washington, DC 20004

In re Application of	:	
QUIN, Bertram Francis Charles	:	DECISION ON
Application No.: 10/725,040	:	
Filing Date: 02 December 2003	:	PETITION
Attorney Docket No.: P69287US1	:	
For: FERTILISER COMPOSITIONS	:	UNDER 37 CFR 1.137(b)

Applicant's petition "Petition For Revival of an Application For Patent Abandoned Unintentionally Under 37 C.F.R. 1.137(b)," filed in the United States Patent and Trademark Office on 11 March 2004 is **GRANTED**.

BACKGROUND

On 02 December 2003, applicant filed a transmittal letter for a continuation application accompanied by a specification and a preliminary amendment.

On 03 March 2004, the Office mailed Notice to File Missing Parts of Non Provisional Application.

On 11 March 2004, applicant submitted this petition under 37 CFR 1.137(b) accompanied by a post card receipt.

RECEIVED
MAY 11 2004
OIPE
JCMS

DISCUSSION

The 11 March 2004 petition to revive was accompanied by a postcard receipt dated 02 December 2003 and a statement that it was a cop of the 02 December 2003 petition. The 11 March 2004 petition is accepted as having been received on 02 December 2003.

A petition to revive an abandoned application under 37 CFR 1.137(b) must be filed without intentional delay from the time the application became abandoned and/or applicant first became aware of the abandoned status of the application. A petition under 37 CFR 1.137(b) must be accompanied by (1) a statement that the entire delay in filing the required reply from the due date for the reply until the filing of a grantable petition was unintentional, (2) a proposed response, (3) the petition fee required by law (37 CFR 1.17(m)), and (4) a terminal disclaimer and fee (if the international application was filed prior to June 8, 1995).

Applicant states "the entire delay in filing the required reply from the due date for the required reply until the filing of a grantable petition under 37 CFR 1.137(b) was unintentional," as required by 37 CFR 1.137(b)(3). The appropriate petition fee has been paid. A proper response

in the form of a continuing application under 35 U.S.C. 111(a) has been submitted. A terminal disclaimer is not required as the application was filed on or after 08 June 1995. Accordingly, all requirements under 37 CFR 1.137(b) have been satisfied.

CONCLUSION

The petition to revive international application PCT/NZ02/00077 abandoned under 37 CFR 1.137(b) is **GRANTED** as to the National Stage in the United States of America for purposes of continuity only and since continuity has been established by this decision reviving the international application, the international application is again abandoned in favor of the present continuing application number 10/725,040.

This application is being forwarded to the Office of Initial Patent Examination for processing as a regular U.S. application under 35 U.S.C. 111(a).

Erin M. Pender

Erin M. Pender
Attorney Advisor
PCT Legal Administration

Telephone: (703) 305-0455
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HAND CARRY TO PCT LEGAL
CRYSTAL PLAZA II, 7TH FLOOR

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Bertram Francis Charles QUIN

Serial No.: 10/725040 Attn: PCT Legal

Filing Date: December 2, 2003

For: FERTILISER COMPOSITIONS

RECEIVED
11 MAR 2004
Legal Staff
International Division

TRANSMITTAL LETTER FOR RECONSTRUCTING FILE

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

A PCT application, PCT/NZ02/00077 filed April 26, 2002 stemming from a New Zealand priority filed May 9, 2001 was not timely perfected and this was unintentional. In order to avert a statutory bar based on publication, an application was filed without priority on November 14, 2003 and this application has been Serial No. 10/712252. Once the facts were determined a PCT continuation application was filed on December 2, 2003, this application is a duplicate of Serial No. 10/712252, and this PCT continuation application has been given Serial No. 10/725040. With this PCT application was contained a Petition for Revival of an Application for Patent Abandoned Unintentionally Under 37 C.F.R. 1.137(b). Attached hereto is the complete file for Serial No.

05/06/2004 CSHOOT 00000002 061358 10725040
Sale Ref: 00000002 DA#: 061358 10725040
01 FC:1453 1330.00 DA

10/725040 and it will be seen that the Petition for Revival is referred to on the two postcards attached and is contained in the enclosures.

Counsel has received a Notice of Missing Parts both on the duplicate filed Serial No. 10/712252 (extensions of time start April 10, 2004) and on Serial No. 10/725040 (extension of time start May 3, 2004).

In order to determine the status of the Petition counsel called PCT Legal only to find out that the IFW file of Serial No. 10/725040 did not contain the Petition to Revive. That is the reason why copies of these documents are being hand carried to PCT Legal so as to remake your file and request that you urgently act on this Petition to Revive.

Any questions please call the undersigned.

Respectfully submitted,

JACOBSON HOLMAN PLLC

By _____

John C. Holman
Reg. No. 22,769

400 Seventh Street, N.W.
Washington, D.C. 20004-2201
(202) 638-6666
Atty. Docket: P69287US1
Date: March 10, 2004

JCH/dls
Enclosures: Complete file as deposited 12/2/03

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Bertram Francis Charles QUIN

International Appln. No.: PCT/NZ02/00077 Attn: Office of Petitions

International Filing Date: April 26, 2002 Box DAC

For: FERTILISER COMPOSITIONS

PETITION FOR REVIVAL OF AN APPLICATION FOR PATENT ABANDONED UNINTENTIONALLY UNDER 37 C.F.R. 1.137(b)

Commissioner for Patents
Washington, DC 20231

Sir:

The above-identified application, namely PCT/NZ02/00077 which designated the United States is abandoned for failure to perfect the filing in the United States within 30 months from the underlying New Zealand priority which is dated May 9, 2001. Therefore, this application should have been perfected in the United States on or before November 9, 2003.

A petition fee in the amount of $1330 under 37 C.F.R. §1.17(m) is attached hereto. Should this amount prove insufficient, or the credit card request become detached, authorization is herewith given to charge undersigned counsel's deposit account 06-1358.

A proper reply for lodging this application in the United States is attached in the form of a PCT continuation application along with the appropriate fee.

A Terminal Disclaimer is not necessary since the effective filing date of this application is after June 8, 1995.

The entire delay in filing the required reply from the due date for reply until the filing of a grantable Petition under 37 C.F.R. §1.137(b) was unintentional.

Early indication that this Petition has been granted and the PCT continuation application, which unintentionally was not filed in the United States is given a filing date, is courteously awaited.

Respectfully submitted,

JACOBSON HOLMAN PLLC

By: _____
John C. Holman
Reg. No. 22,769

400 Seventh Street, N.W.
Washington, DC 20004
(202) 638-6666
Atty. Dkt. No.: P69287US1
Date: December 2, 2003

Enclosures: Petition Fee
Order letter and papers necessary for filing
a PCT continuation application

Att'y Docket No.: P69287US1
Serial No.: New PCT Continuation Application
Applicant: QUIN
Filing Date: December 2, 2003

Today's Date: December 2, 2003

The following has been received in the U.S. Patent & Trademark Office on the date stamped hereon:

X Petition for Revival and Credit Card Form
X Preliminary Amendment
X 12 pp. Specification, including 44 Claims and Abstract
X Drawings 2 Sheets

DUE DATE: ASAP



JACOBSON HOLMAN PLLC
400 SEVENTH STREET, NW
WASHINGTON, DC 20004

JCH/cmf

Att'y Docket No.: P69287US1
Serial No.: New PCT Continuation Application
Applicant: QUIN
Filing Date: December 2, 2003

Today's Date: December 2, 2003

The following has been received in the U.S. Patent & Trademark Office on the date stamped hereon:

X Petition for Revival and Credit Card Form
X Preliminary Amendment
X 12 pp. Specification, including 44 Claims and Abstract
X Drawings 2 Sheets

'22581 U.S. PTO
10/725040



DUE DATE: ASAP

JACOBSON HOLMAN PLLC
400 SEVENTH STREET, NW
WASHINGTON, DC 20004

EARLY SERIAL NO. _____

JCH/cmf

LAW OFFICES OF
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December 2, 2003

Atty. Docket No.: P69287US1
CUSTOMER NUMBER: 00136

Mail Stop PATENT APPLICATION
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Transmitted herewith for filing is a CONTINUATION application of PCT/NZ02/00077 filed on April 26, 2002 of **Bertram Francis Charles QUIN** for **FERTILISER COMPOSITIONS** and which is hereby incorporated by reference. The application comprises a **12**-page specification, including **44** claims (13 independent) and Abstract, and **2** sheets of drawings.

Accompanying the application for filing is:

Preliminary Amendment.

A certified copy of **New Zealand** Application No. **511606**, filed **May 9, 2001**, will follow in due course, the priority of which is claimed under 35 U.S.C. §119 and which is hereby incorporated by reference.

This application is being filed under 37 C.F.R. §1.53(f) (without Declaration or Filing Fee). The required Declaration and Filing Fee will be filed subsequently.

Should a fee be necessary to obtain a filing date, e.g. paying the basic fee for nationalizing a PCT application, the Commissioner is hereby authorized to charge payment of any fees set forth in §§1.17 or 1.492 during the pendency of this application, or credit any overpayment, to Deposit Account No. 06-1358. A duplicate copy of this sheet is enclosed.

Respectfully submitted,

JACOBSON HOLMAN PLLC

By _____
John C. Holman
Reg. No. 22,769

cmf

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Bertram Francis Charles QUIN

Serial No.: New

Filing Date: December 2, 2003

For: FERTILISER COMPOSITIONS

PRELIMINARY AMENDMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Prior to initial examination, please amend the above-identified application as follows:

IN THE SPECIFICATION

On page 1, immediately following the title, please insert the following sentence:

This is a continuation of PCT/NZ02/00077 filed April 26, 2002 and published in English.

REMARKS

The foregoing Preliminary Amendment is requested in order to place the application in better form for examination.

Early action on the merits is respectfully requested.

Respectfully submitted,

JACOBSON HOLMAN PLLC

By _____
John C. Holman
Reg. No. 22,769

400 Seventh Street, N.W.
Washington, D.C. 20004-2201
(202) 638-6666

Atty. Docket: P69287US1
Date: December 2, 2003
JCH/cmf

"FERTILISER COMPOSITIONS"

TECHNICAL FIELD

The present invention relates to fertilisers.

Urea is a frequently used fertiliser as a source of ground and/or plant nitrogen.

Sulphur-coated urea products have been developed and are considered to be useful because

1) urea being a high nitrogen containing product, even when coated, still results in a product having a nitrogen content of about 38 to 44% by weight;
2) sulphur coating of urea reduces leaching of nitrate and volatilisation of nitrous oxide and ammonia;
3) sulphur coating of urea therefore improves the efficiency of utilisation of the nitrogen in the urea;
4) sulphur is relatively cheap; and
5) sulphur is itself a valuable secondary nutrient.
6) such products can be blended with phosphate fertilisers.

Some sulphur coating procedures rely on the addition of additional agents in order to achieve an effective coating whilst others rely upon a melt application procedure. Dry coating procedures have a disadvantage in that the coating, even prior to application as a fertiliser, can become cracked, in which case it breaks off the urea and the coating benefits are lost.

SUMMARY OF THE INVENTION

The present invention recognises the prospect of a simple procedure being utilised to provide an effective coating of urea using sulphur and which additionally has the advantage of being capable of being used in conjunction with the incorporation of nitrification inhibitors and/or urease inhibitors, if required or desired. It is to this therefore that the present invention is directed.

In a first aspect the present invention consists in **a particulate fertiliser composition** of particulate urea (eg; granules or prills) coated with wetground sulphur.

Preferably said wet ground sulphur has been dewatered to some extent (ie; 5 to 20% and most typically to 8 - 15% by weight moisture) prior to the association of such sulphur particles with the urea particles.

Preferably said sulphur particles serially or simultaneously are associated with said urea with a nitrification inhibitor and/or a urease inhibitor.

In another aspect the present invention consists in **a particulate fertiliser composition** of particulate urea coated with both sulphur and a nitrification and/or urease inhibitor.

Preferably said sulphur is wet ground sulphur.

Preferably at least 90% of the said sulphur is of particle size from 10 to 150 microns (preferably of a medium particle size of about 75 microns).

Preferably said urea is in the form of (standard or other) granules or prills and each such particle (ie; granule or prill) has a weight of sulphur plus moisture plus inhibitor added (expressed as a % of the total weight of prill or granule) in the range of from 5 to 25% (more preferably 5 to 20%). Alternatively 10 to 25%.

Preferably said nitrification inhibitor is selected from the group consisting of DCD (dicyandiamide) or DIDIN™ (a DCD containing product of SKW, Germany which also includes ammonium thiosulphate and ammonium phosphate).

Preferably the nitrification inhibitor is incorporated as a fine particle or as a solution.

Preferably the weight percentage of nitrification inhibitor relative to sulphur is in the range of from 5% to 50% by weight (alternatively 10 to 50%)

Preferably the urease inhibitor is AGROTAIN™ Urease Inhibitor, a liquid product (of N-(n-butyl)thiophosphoric triamide in N-methyl pyrrolidone and another solvent) produced by Agrotain International LLC, Indiana, USA.

Preferably the weight percentage of urease inhibitor relative to sulphur is in the range of 2 to 12%.

Preferably the weight percentage of sulphur relative to urea is from 4% to 15% (alternatively 5 to 15% or 10 to 15%).

Preferably said sulphur at the time of its association with the urea has a water content of from 8% to 15%.

Preferably the coating of the urea is with a mixture of the sulphur and the nitrification and/or urease inhibitor.

Preferably said product has been formed by combining sulphur (that has been ground underwater and subsequently de-watered) with the nitrification inhibitor and the subsequent mixing of that mixture with the urea.

In still a further aspect the present invention consists in **a urea based fertiliser** being or having urea granules coated to provide a surrounding matrix of both sulphur and a

nitrification inhibitor, the sulphur binding into the urea to create a mixed urea/sulphur transition zone which may (and preferably does) include some of said nitrification and/or urease inhibitor.

In still a further aspect the present invention consists in a **fertiliser** in granule, prill or the like form having a core of urea, an inner peripheral zone of both at least urea and sulphur and an outer peripheral zone of both at least urea and sulphur and an outer peripheral of at least sulphur.

Preferably one or both of said peripheral zones includes a nitrification and/or urease inhibitor.

In still a further aspect the present invention consists in **a method of preparing a fertiliser from particulate urea** (eg; granules or prills) which comprises or includes mixing such particulate urea (serially and/or simultaneously) with a wetground elementary sulphur and a compatible nitrification and/or urease inhibitor.

Preferably said mixing is simultaneous, ie; the wet ground and de-watered sulphur having previously been mixed with the preferably particulate nitrification and/or urease inhibitor.

Preferably the characteristics of the nitrification and/or urease inhibitor, the sulphur and the urea and their relativities are substantially as previously stated.

In still a further aspect the present invention consists in **a urea granule or prill based fertiliser** having a surround which includes both elementary sulphur and a nitrification and/or urease inhibitor, the sulphur binding or assisting in the binding of the nitrification and/or urease inhibitor to the urea.

Preferably said sulphur was wet ground sulphur.

In still a further aspect the present invention consists in **the fertiliser usage of a fertiliser composition or urea based fertiliser product** as previously stated, ie; by its application to a locus of the ground to be fertilised.

This invention may also be said broadly to consist in the parts, elements and features referred to or indicated in the specification of the application, individually or collectively, and any or all combinations of any two or more of said parts, elements or features, and where specific integers are mentioned herein which have known equivalents in the art to which this invention relates, such known equivalents are deemed to be incorporated herein as if individually set forth.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred forms of the present invention will now be described with reference to the accompanying drawings in which;

Figure 1 shows typical breakdown chemical reactions of urea which generates both N_2O and ammonia in addition to forms of nitrogen which can be utilised by plants, and

Figure 2 shows a flow diagram of a preferred process in accordance with the present invention, etc.

DETAILED DESCRIPTION OF THE INVENTION

As used herein the term "wet grinding" in relation to sulphur involves any physical modification of the sulphur by physical or mechanical means in a liquid environment and preferably water with a view to size reduction.

Details of one such procedure developed by M W Brown of New Zealand Pastoral Agriculture Research Institute Limited (possibly subsequently assigned to HiTech Products Limited and subject to their NZ Patent Application 337251) was disclosed in the Agritech 2000 TV Programme 18 recorded 5 September 1997 and broadcast in New Zealand.

The aforementioned TV Agritech 2000 TV Programme 18 makes reference to a milkshake type dispersing apparatus to reduce the size of the sulphur in water. They attributed to that crude disperser process the prospect of size reduction dependent on water to sulphur ratio, dependent on duration of disperser use and dependent on speed of the disperser in to the there depicted accumulations of 0.25 mm, 0.15 mm, 0.075 mm and less than 0.075 mm wet ground sulphur.

A suitable disperser for such purpose could be that as used in that programme or that subsequently used by HiTech Products Limited. Other suitable dispersers for such a process are those of IKA and Silverson.

It is to the production of such size reduced sulphur with its consequential characteristics that the term "wet grinding" (or variations of the term) relates even if it is not what would be considered as grinding or milling if in a dry environment.

The de-watering step referred to in Figure 2 is preferably no more than a physical de-watering procedure such as might occur by pouring the sulphur slurry into porous bags and applying pressure to force excess water out and thereafter conditioning the resultant moist sulphur solids to break up soft lumps of sulphur.

The mixing procedure can be in any suitable blending apparatus for the initial introduction of the nitrification and/or urease inhibitor. Likewise the same or a different mixing or blending apparatus can be used for blending the urea into (as preferred) the pre-existent mix of the wetground sulphur and the nitrification and/or urease inhibitor.

The resultant product, which is a pale yellow in appearance, otherwise has much the same physical appearance of uncoated urea granules or prills and has similar free flow characteristics without any ready tendency to shed the coating.

Where the main requirement for sulphur is as a nutrient in its own right, and to help reduce ammonia volatilisation through reducing the pH around the granules, sulphur addition is more likely to be in the 4 to 10% weight range relative to the urea.

Where the main requirement for sulphur is to make a urea coated product that can be blended with soluble phosphate fertilisers, sulphur addition is more likely to be in the 10-15% weight range relative to the urea.

1. A particulate fertiliser composition of particulate urea coated with wet ground sulphur.

2. A composition of claim 1 in the form of granules or prills.

3. A composition of claim 1 wherein said wet ground sulphur has been dewatered to some extent prior to the association of such sulphur with the urea.

4. A composition of claim 3 wherein said dewatering has been to 8 to 15% moisture.

5. A composition of claim 3 wherein said dewatering has been to 5 to 20% moisture.

6. A composition of claim 1 wherein said sulphur has been associated with said urea serially (before or after) or simultaneously with a nitrification inhibitor.

7. A composition of claim 1 wherein said sulphur has been associated with said urea serially (before or after) and/or simultaneously with a urease inhibitor.

8. A particulate fertiliser composition of particulate urea coated with both sulphur and a nitrification inhibitor.

9. A particulate fertiliser composition of particulate urea coated with both sulphur and a urease inhibitor.

10. A composition of claim 8 wherein said sulphur is wet ground sulphur.

11. A composition of claim 10 wherein at least 90% of the said sulphur is of particle size from 10 to 150 microns of a median particle size of about 75 microns.

12. A composition of claim 1 wherein said urea is in the form of granules or prills and each such granule or prill has a weight of wet ground sulphur plus moisture plus inhibitor added (expressed as a % of the total weight of prill or granule) in the range of from 5 to 20%.

13. A composition of claim 12 wherein each such granule or prill has a weight of sulphur plus moisture plus inhibitor added (expressed as a % of the total weight of prill or granule) in the range of from 10 to 20%.

14. A composition of claim 10 wherein the sulphur at the time of the coating had a moisture content of from 8 to 15% by weight.

15. A composition of claim 8 wherein the nitrification inhibitor is incorporated as fine particles or as a solution.

16. A composition of claim 15 wherein the weight percentage of nitrification inhibitor relative to sulphur is in the range of from 5% to 50%.

17. A composition of claim 16 wherein the weight percentage of nitrification inhibitor relative to sulphur is in the range of from 10% to 50%.

18. A composition of claim 9 wherein the weight percentage of urease inhibitor relative to sulphur is in the range of I to 12%.

19. A composition of claim 1 wherein the weight percentage of sulphur relative to urea is from 4% to 15%.

20. A composition of claim 19 wherein the weight percentage of sulphur relative to urea is from 8% to 15%.

21. A composition of claim 19 wherein the weight percentage of sulphur relative to urea is from 4% to 10%.

22. A composition of claim 19 wherein the weight percentage of sulphur relative to urea is from 10% to 15%.

23. A composition of claim 19 wherein said sulphur at the time of its association with the urea has a water content of from 8% to 15%.

24. A composition of claim 8 wherein the coating of the urea is with a mixture of the sulphur and the nitrification inhibitor.

25. A composition of claim 9 wherein the coating of the urea is with a mixture of the sulphur and the urease inhibitor.

26. A composition of claim 8 wherein the coating of the urea is with a mixture of the sulphur and both a nitrification inhibitor and an urease inhibitor.

27. A composition of claim 24 wherein said product has been formed by combining sulphur (that has been ground underwater and subsequently de-watered) with the nitrification inhibitor and the subsequent mixing of that mixture with the urea.

28. A composition of claim 25 wherein said product has been formed by combining sulphur (that has been ground underwater and subsequently de-watered) with the crease inhibitor and the subsequent mixing of that mixture with the urea.

29. A urea based fertiliser being or having urea granules coated to provide a surrounding matrix of both sulphur and a nitrification inhibitor, the sulphur binding into the urea to create a mixed urea/sulphur transition zone which may include some of said nitrification inhibitor.

30. A urea based fertiliser being or having urea granules coated to provide a surrounding matrix of both sulphur and a urease inhibitor, the sulphur binding into the urea to create a mixed urea/sulphur transition zone which may include some of said urease inhibitor.

31. A urea based fertiliser being or having urea granules coated to provide a surrounding matrix of sulphur, a urease inhibitor and a nitrification inhibitor, the sulphur binding into the urea to create a mixed urea/sulphur transition zone which may include some of one or both of said nitrification and urease inhibitors.

32. A fertiliser in granule, prill or the like form having a core of urea, an inner peripheral zone of both at least urea and sulphur and an outer peripheral zone of both at least urea and sulphur and an outer peripheral zone of at least sulphur.

33. A fertiliser of claim 32 wherein one or both of said peripheral zones includes a nitrification inhibitor.

34. A fertiliser of claim 32 wherein one or both of said

peripheral zones includes a urease inhibitor.

35. A fertiliser of claim 32 wherein one or both of said peripheral zones includes both a nitrification and urease inhibitor.

36. A method of preparing a fertiliser from particulate urea which comprises or includes mixing such particulate urea (serially and/or simultaneously) with a wetground elementary sulphur and a compatible nitrification inhibitor.

37. A method of preparing a fertiliser from particulate urea which comprises or includes mixing such particulate urea (serially and/or simultaneously) with a wetground elementary sulphur and a compatible nitrification and urease inhibitor.

38. A method of preparing a fertiliser from particulate urea which comprises or includes mixing such particulate urea (serially and/or simultaneously) with a wetground elementary sulphur and a compatible nitrification and urease inhibitor.

39. A method of claim 36 wherein said mixing is simultaneous, ie; the wet ground and de-watered sulphur having previously been mixed with the preferably particulate nitrification and/or urease inhibitor.

40. A urea granule or prill based fertiliser having a surround which includes both elementary sulphur and a nitrification inhibitor, the sulphur binding or assisting in the binding of the nitrification inhibitor to the urea.

41. A urea granule or prill based fertiliser having a surround which includes both elementary sulphur and a urease inhibitor, the sulphur binding or assisting in the binding of

the urease inhibitor to the urea.

42. A urea granule or prill based fertiliser having a surround which includes both elementary sulphur and a urease inhibitor, the sulphur binding or assisting in the binding of the urease inhibitor to the urea.

43. A urea granule or prill based fertiliser as claimed in claim 40 wherein said sulphur was wet ground sulphur.

44. The fertiliser usage of a fertiliser composition or fertiliser of claim 1.

ABSTRACT

A fertiliser composition in the form of granules or prills where urea has been coated with wet ground sulphur. The wet ground sulphur is preferably applied serially and/or simultaneously with one or both of a nitrification inhibitor and a urease inhibitor.

In its preferred form there is a core of urea and an inner peripheral zone of both at least urea and sulphur. The outer peripheral zone can be of at least urea and sulphur or at least sulphur, or both.

Chemical reactions involving urea and its reaction products in the soil

(a) Hydrolysis of urea to ammonium

$(NH_2)_2CO$ (urea) + H_2O (water in soil) $\xrightarrow{\text{urease enzyme}}$ $(2NH_4)_2CO_3$ (ammonium carbonate) (1)

$(NH_4)_2CO_3 \underset{\text{dependent}}{\overset{\text{condition}}{\rightleftharpoons}} NH_4^+$ (ammonium ions) + $NH_3(\uparrow)$ (ammonia gas) + $CO_2(\uparrow)$ (carbon dioxide gas) + OH^- (hydroxide) (2)

(b) Oxidation of ammonium to nitrate ("nitrification")

$2NH_4^+ + O_2 \xrightarrow[\text{bacteria}]{\text{Nitrosomonas}} 2NH_2OH + 2H^+$ (3)

$2NH_2OH + O_2 \longrightarrow N_2O(\uparrow)$ (nitrous oxide gas) $+ 3H_2O$ (4)

$2N_2O + 2O_2 + 2H_2O \xrightarrow[\text{bacteria}]{\text{Nitrosomonas}} 4NO_2^-$ (nitrite (transient)) $+ 4H^+$ (5)

$2NO_2^- + O_2 \xrightarrow[\text{bacteria}]{\text{Nitrobacter}} 2NO_3^-(\downarrow)$ (nitrate (leachable)) (6)

Notes:

Reaction (2) gives rise to losses of ammonia gas (NH_3)
Reaction (4) gives rise to losses of nitrous oxide gas (N_2O)
Reaction (6) gives rise to leaching of nitrate (NO_3^-)
Reaction (2) gives rise to temporary increase in pH
Reactions (3) and (5) give rise to ultimate decrease in pH

- Urease "inhibitor" acts by directly slowing the rate of reaction (1) and by indirectly slowing the rate of reactions (2) - (6)
- Nitrification "inhibitors" act by slowing some or all of reactions (3) - (6)
- Sulphur-coating reduces the speed with which the conversion of urea to other products can take place, principally by slowing contact of the urea with water and oxygen, and reducing the pH near the granule.

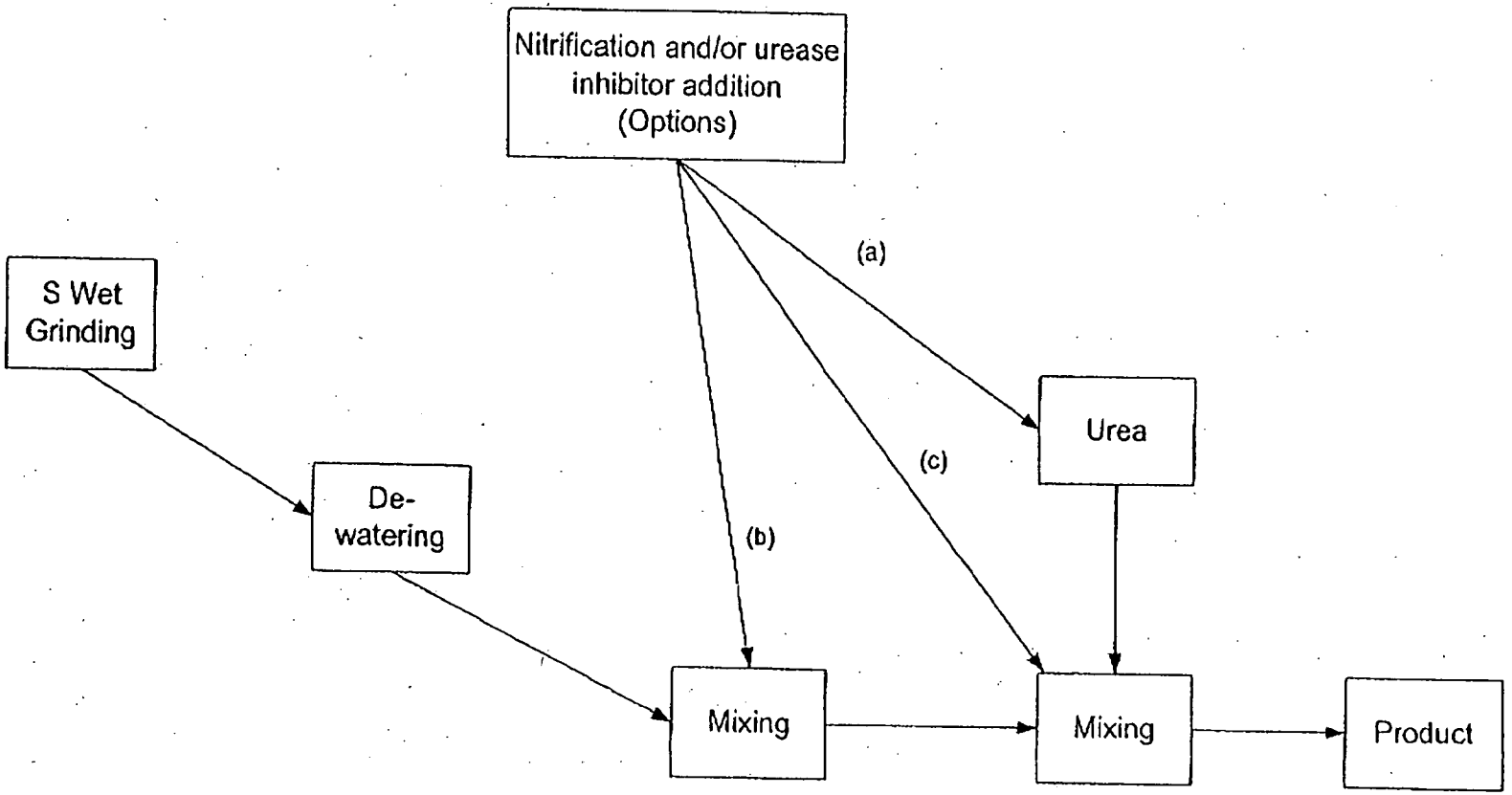

Nitrification and/or urease inhibitor addition (Options)
S Wet Grinding
De-watering
Urea
(a)
(b)
(c)
Mixing
Mixing
Product

FIGURE 2